



TC3 Workshop: Cognitive Elements of Effective Collaboration.



Theater Assessment Profiling System (TAPS) Contribution to Coalition Collaboration

Briefing on an advanced visualization scheme powered by a state space “engine” process in support of shared situation awareness, collaboration, and decision making

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Overview

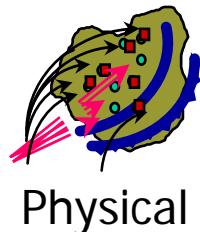
- Effective SA in a JTF
- Definitions
- Goal of TAPS Contribution to Collaboration
- VSS “Under the Hood”
- Global War Game 2001 TAPS
- Situation Assessment
- Experimental Design
- Prototype and Top Sight™
- Summary



Requirements for Effective SA in a Joint Task Force (JTF) Setting

Real-world Situation

Theater
"World"



Physical

+

Clausewitz's
"Red"
Moral and
Mental

Processes

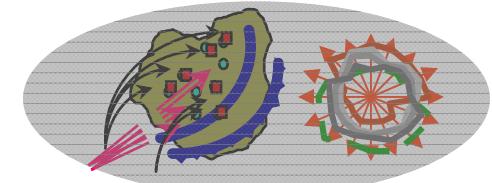
- Perception *
- Attention *
- Patterns & Long Term Memory *
- Synthesis, Analysis and Metacognitive Processes *

Product

Memory

Working Memory / Long-term Memory

Goals
Expectations
Mental Models
Schema



Force Location, Blue Plan & Type, Strength Red Effects

Internal Representation of STATE

Mechanisms and Processes

Involved in SA (Endsley, 2000 in
Theoretical Underpinnings of Situation Awareness: A critical Review)

* TAPS
Contributions

Stress - Work-load - Interface - Complexity - Automation



Descriptions of TAPS & VSS

- **TAPS – Theater Assessment Profiling System**- An Effects-Based Operations (EBO) visualization that provides:
 - Commander's single view of his critical information environments as they progress, stagnate or fail (retrograde).
 - A high-level integrated view with "tailorable drilldown" enabled the commander to focus on normally disparate activities in the battlespace.
 - Explicit adversary and friendly (joint/coalition) EBO depictions
- **VSS – Valuated State Space™** - A model utilizing multi-attribute utility theory that:
 - Mathematically captures the commander's intent, the desired effects on the enemy and unintended consequences for his planning-to-execution domain.
 - Incorporates the commander's priorities
 - Fuses and normalizes objective metrics and expert subjective data
 - Defines objectives using measures of effects
 - Defines measures of performance with intervals of achievement

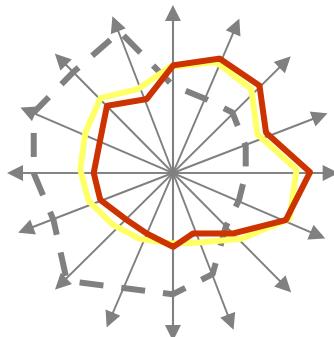


Goal of TAPS Contribution to Coalition Collaboration

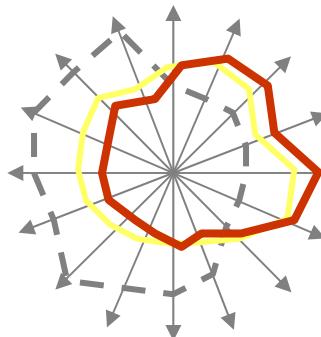
TAPS Contribution to Coalition Collaboration

- Facilitates collaboration between elements by highlighting differences in team SA between the major elements, such as, JFMCC, JFACC, JFLCC and coalition partners
- Visualizes situation assessment of joint/coalition high-level purpose and achieved effects on the enemy
- Provides access to lower level details for further specification of differences

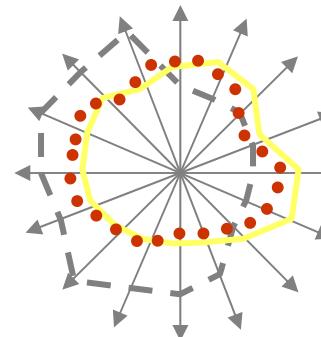
TAPS-VSS Environments Components and Coalition



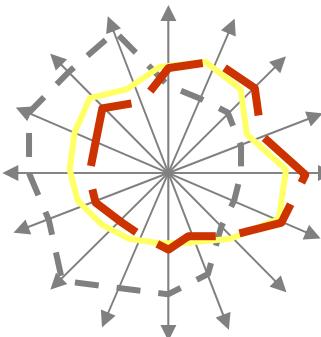
JFMCC



JFACC



JFLCC

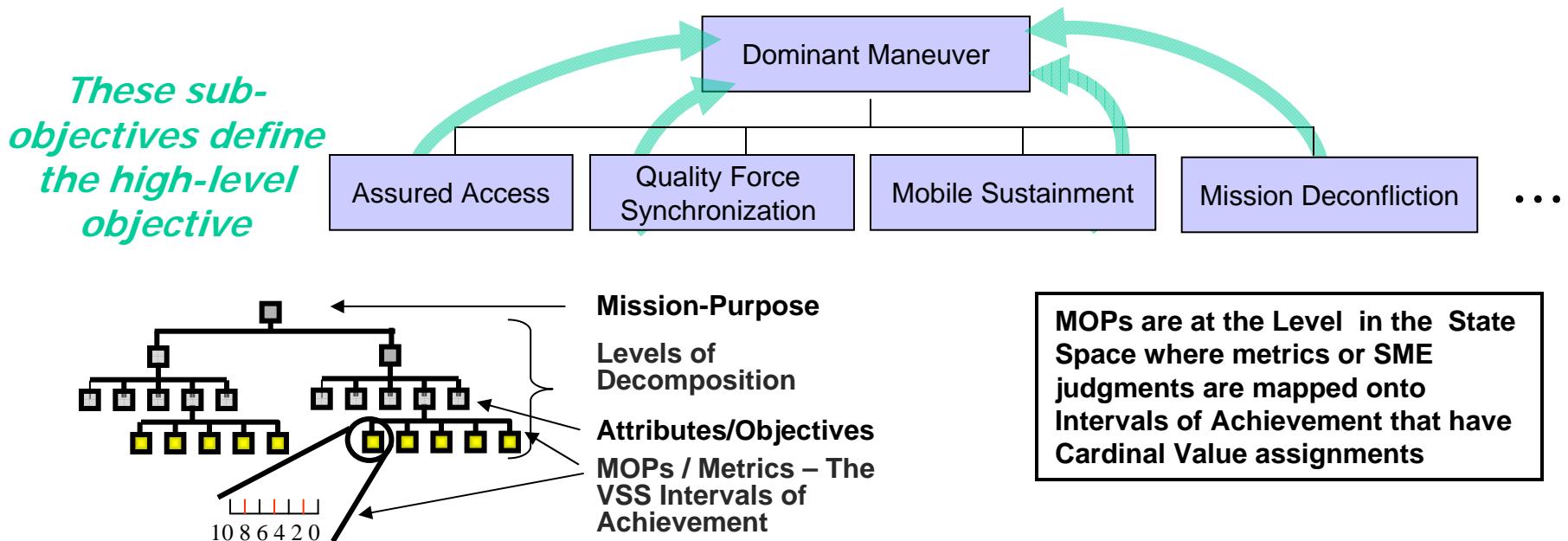


Coalition
Partner



VSS™ Functionality -“Under the Hood”

- Decomposition of an objective into lower-level, more detailed sub-objectives



- Operational Environment: Objectives must be useful to be meaningful to the decision-maker. Objectives should facilitate explanations to others.
- Completeness: A set of subobjectives, i.e. the state space, is complete if it is effective in indicating the degree to which the overall objective is met.
- Non-redundancy: Objectives in the Valuated State Space should be preferentially distinguishable

* Hierarchy of Objectives from *Decisions with Multiple Objectives: Preferences and Value Tradeoffs* by Keeney and Raiffa



VSS Under the Hood

Key Characteristics

Subject Matter Expert inputs for:

- Determining mission-purpose
- Constructing the state space
- Determining “importance weight” of each objective/attribute
- Establishing the achievement / assessment criteria and numeric cardinal value assignments, i.e., utilities.
- Defining intervals of achievement for Measures of Performance (MOPs) through which utility values are assigned

Logic engine that produces values for the TAPS display

Mathematical/Computational Normalization Process

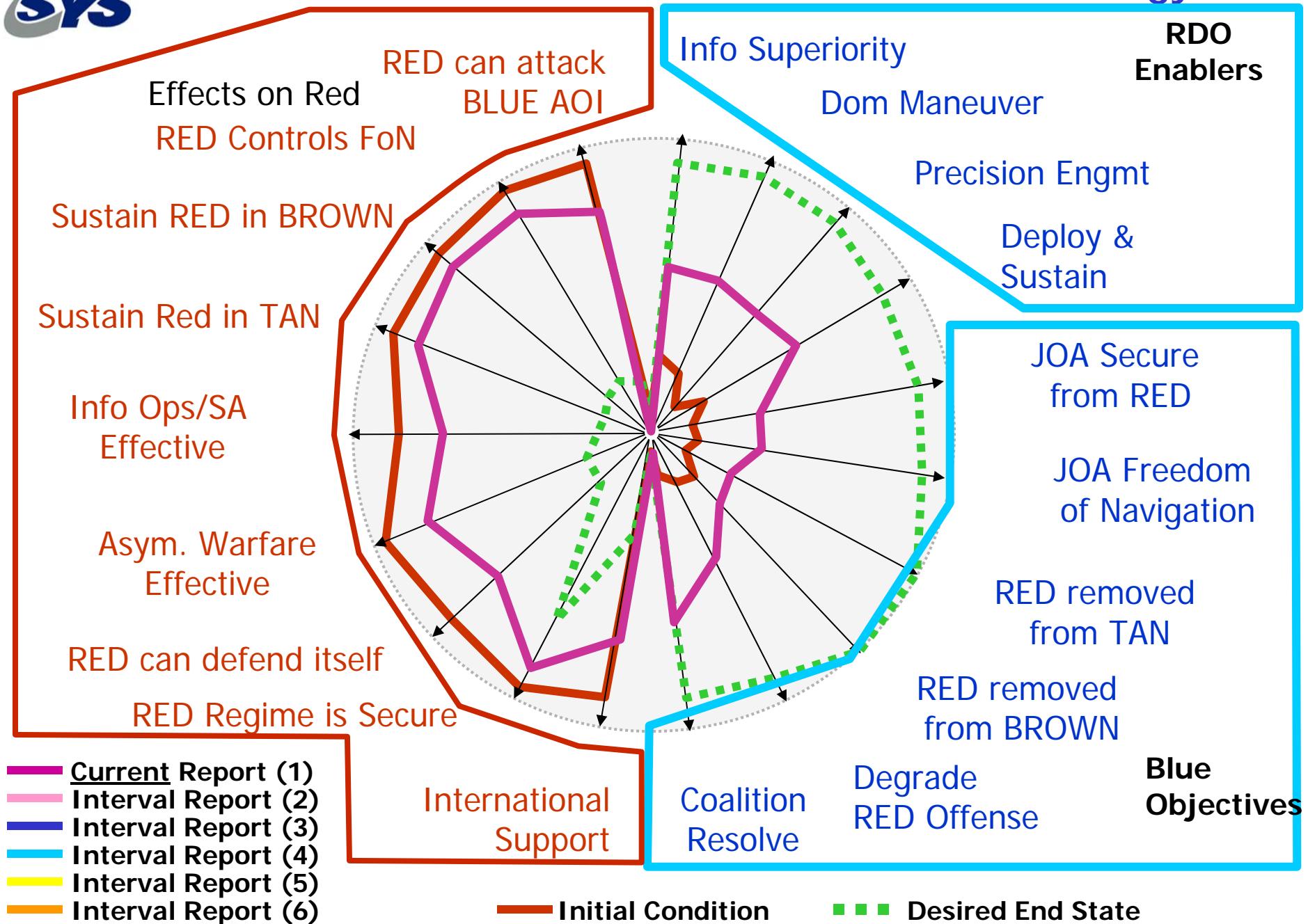
- Arithmetic & geometric means and default thresholds
- **Future Research:** Incorporation of other data sources, NSS
- **Future Research:** Evolutionary computation, fuzzy logic, etc.

What is needed to operate the TAPS-VSS model?

- Context
- Mission-Objectives (CCIRs,)
- SMEs
- Calibration of SMEs at MOP level
- Maintain Calibration of SME Population

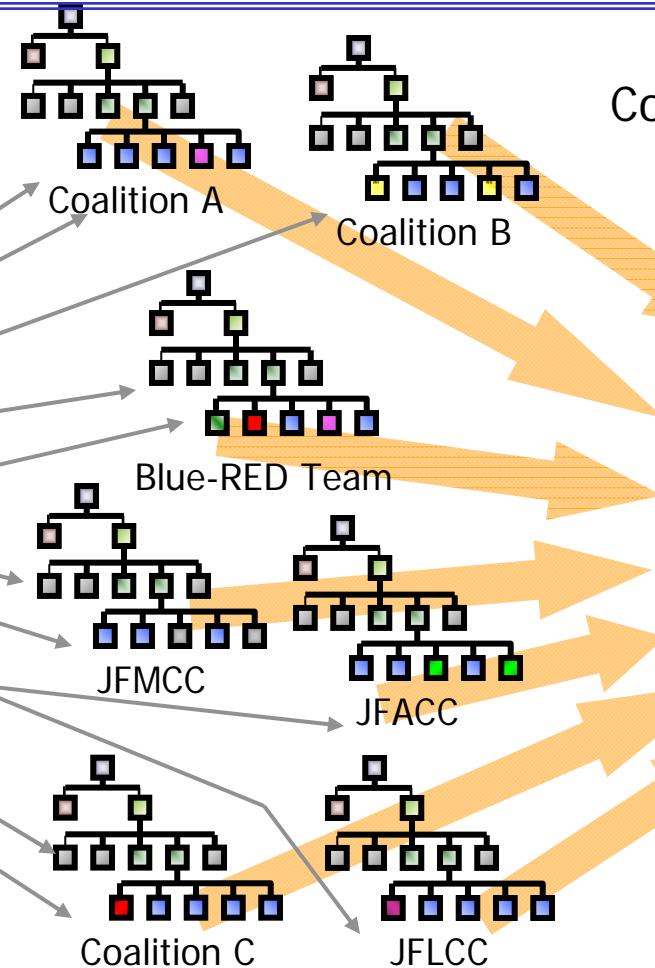
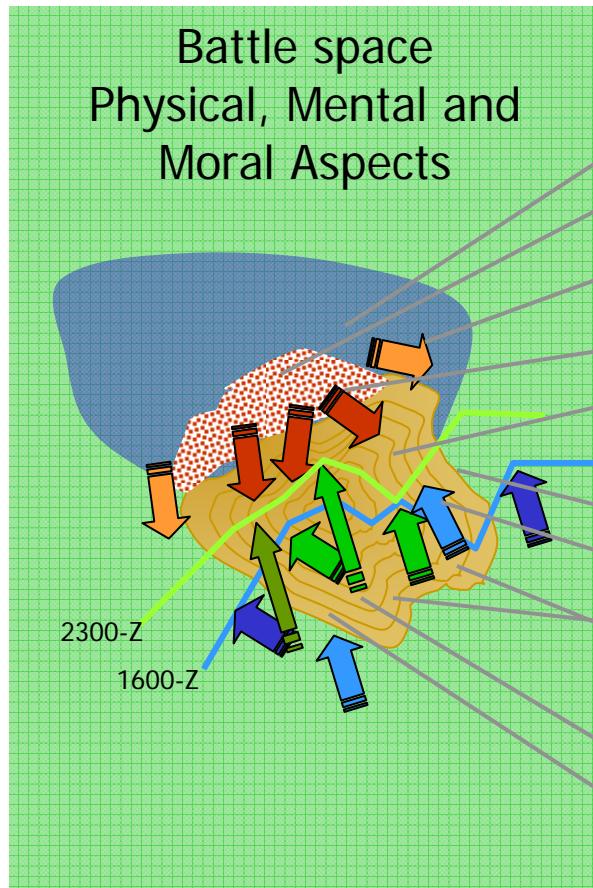


GLOBAL 2001 – TAPS – Effects on RED & BLUE Strategy

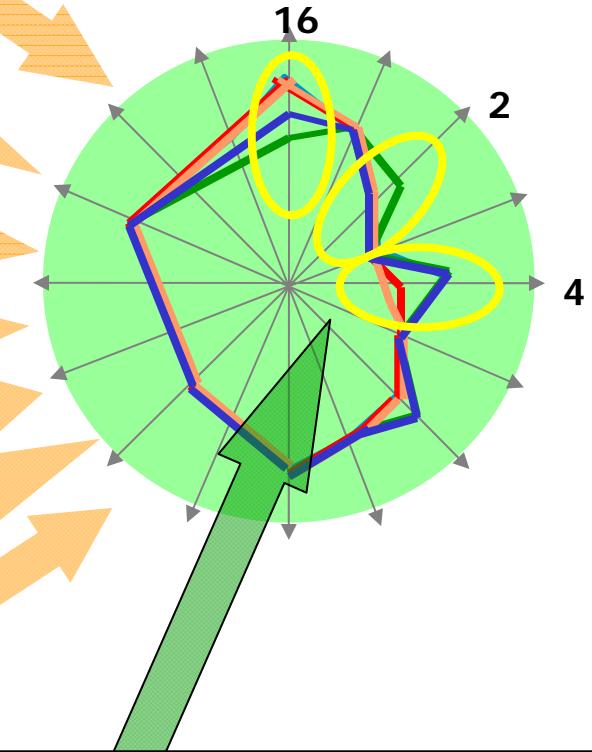




Situation Assessment Deltas Identified and Highlighted by Major JTF Element



Combined JTF Effects Status
Collaboration Display



- Data collected for major elements shown in Combined Display
- Yellow Show Deltas in Situation Assessment by High-level purpose
- Drill down into Vectors 16, 2 and 4 will disclose details



Drill Down to
Second level
MOEs

High-Level Display

BLUE ACCESS ASSURANCE

RED ANTI-ACCESS
AND OFFENSIVE DEPTH

RED MILITARY
WILL TO FIGHT

RED C2-C4ISR
STABILITY

KORU
POLITICAL
RESOLVE

CYBERSPACE
ACCESS

BLUE'S
FON

BLUE CRITICAL
RESOURCES

BLUE-COALITION
POL-MIL STABILITY

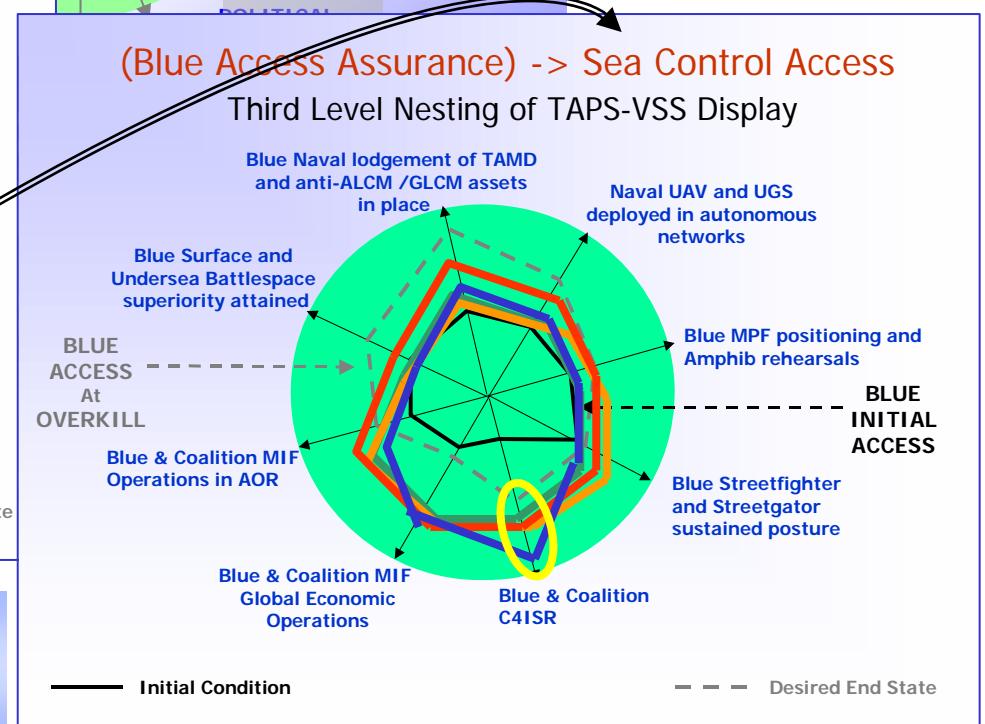
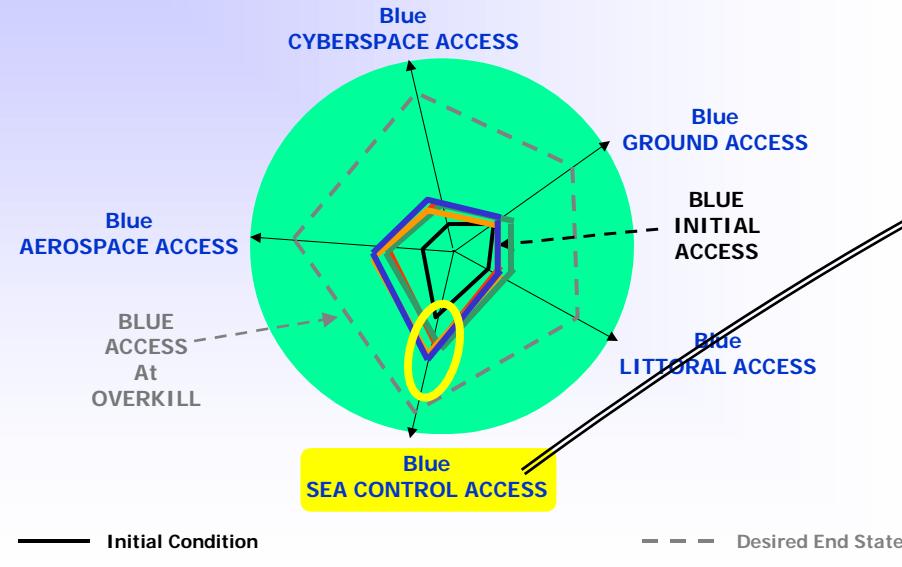
KORU
POSITION

Blue Access Assurance Vector
Second Level Nesting of TAPS-VSS Display

Drill Down to
Third level
MOEs/MOPs

(Blue Access Assurance) -> Sea Control Access

Third Level Nesting of TAPS-VSS Display



Level 2 SA – Comprehension
Enabled by Detailed Views of MOE's



2x2 Experimental Design

Innovative Concept to Enhance JTF & CTF Collaboration

	Training	Trial I	Trial II	
Treatment A TAPS-VSS	1. Experiment set-up, org., process, scenario, etc. 2. Treatment technologies 3. Schedules 4. Debrief Questionnaires	Situation Briefs CG Scenario	Situation Briefs CG Scenario	Debrief
Treatment B TBD		Situation Briefs CG Scenario	Situation Briefs CG Scenario	Debrief

- Teams of Component/Coalition Commanders

1. JFMCC
2. JFACC
3. JFLCC
4. Coalition Country A
5. Coalition Country B

- Data Collection

1. Questionnaires
2. Debriefings
3. Observations
4. Situation Awareness probes

✓ Cobra Gold 02
✓ FBE-J

- Success Criteria

1. Improved Situation Assessments for Components/Coalition
2. Identification of specific "CCIR Deltas" in Situation Assessment between JTF Elements
3. Improved collaboration

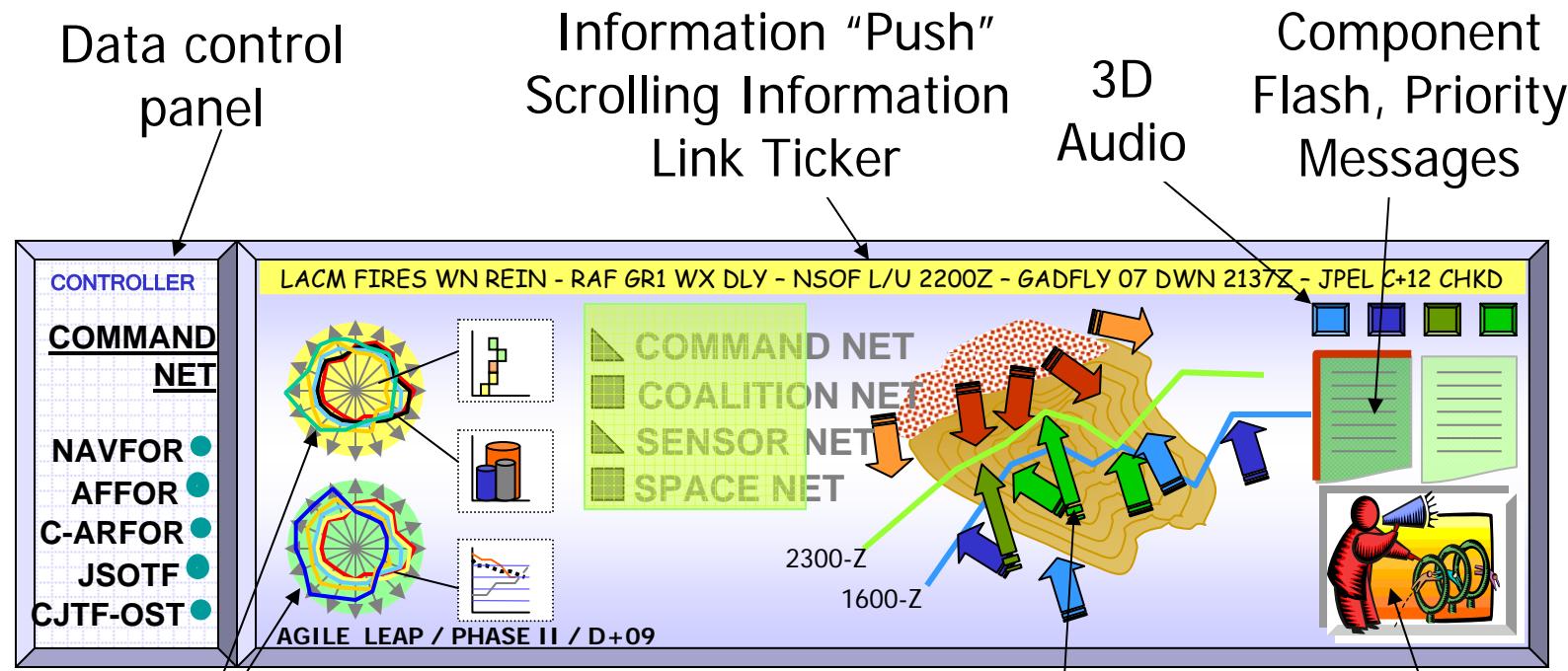


TAPS-VSS Prototype

- TAPS Prototype Events
 - Global Wargame 2000 (August) & 2001 (July)
 - The VSS metrics construct was validated as an appropriate way to track disparate topics relevant to the commander
 - TAPS as a prototype visualization provided both a high level roll-up assessment of input data and illustrated trend progression, stagnation or retrograde
 - US Joint Forces Command Presentation LOE – July '01
 - Formal Report due Dec 01
- Scheduled Events
 - Cobra Gold 02 – Attended USPACOM Joint Mission Force PC and CG02 IPC and MPC. Attending FPC in mid Jan 2002.
 - Fleet Battle Experiment Juliet – Attended IPC/MPC



Top Sight™ Command Information Viewport



TAPS trend reports on
'Commander's Intent' progression
and Element Situation Assessments

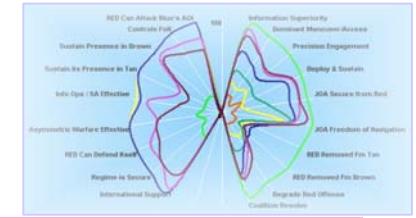
Battlespace
Maneuver Situation

VTC
Port

Personnel Digital Assistant/Tablet
Viewport for Coalition Partners



Summary



- TAPS-VSS was successfully used in Global Wargame 2000 & 2001, and JFCOM UV01 Presentation LOE
- Senior Military Leadership has encouraged continued development
- Navy operational and technical communities are supportive and participating
- Improved prototype targeted for FBE – Juliet and Cobra Gold 02
- SYS working to develop Component/Coalition Shared SA and Situation Assessment Collaboration Scheme
- Experimentation, research and studies continue